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Rooting development of *Sansevieria trifasciata* (Mother-In-Law Tongue) as influenced by different propagation substrates

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Abstract— *Substrates are materials, other than soils in situ, in which plants are grown, and it is often used synonymously with rooting medium. An experiment was conducted at the Crop Type Museum of the Department of Crop, Soil, and Pest Management, the Federal University of Technology, Akure, to determine the rooting development of Sansevieria trifasciata as influenced by different propagation substrates. Results showed that the performance of the Sansevieria trifasciata planted using sand as substrate enhanced growth and root development of Sansevieria trifasciata compare to other substrates used (topsoil, sawdust, and rice hull). The treatment combination of all the substrates Topsoil + Sawdust + Rice hull + Sand performed better than other treatment combinations and sole. This study provided the empirical evidence that substrate combination influenced root development of Sanseveria spp.*

Keywords— Rooting media, Sanseveria spp, Ornamental, Substrate, Growth.

I. INTRODUCTION

Sansevieria spp. is a perennial herb found in dry tropical and subtropical parts of the world (Randall, 2012).It is considered a “noxious weed” and of great economic importance as an ornamental plant, the source of fibre and as a medicine for curing different ailments. In Nigeria, theleaves and roots of *Sansevieria spp.*are used intraditional medicine for the treatment of asthma,abdominal pains, colic, diarrhea, eczema, gonorrhea,hemorrhoids, hypertension, menorrhagia, piles,sexual weakness, snakebites and wounds of the foot (Osabohien and Egboh, 2008; Ikewuchi *et al.*, 2010).

The term ‘growing medium’ is amongst others used to describe the material used in a container to grow a plant. The terms ‘substrate’ (Schroeder and Sell, 2009; Vaughn et al., 2011) and ‘rooting medium’ (Blok and Verhagen, 2009) are also used as synonyms. In some text, the term ‘compost’ is often used in place of growing medium. Nair et al. (2011) describe compost as a product obtained as a result of composting operation. For example, a compost heap at the bottom of the garden. However, composted materials have routinely been used as a growing medium or components of growing media (Schroeder and Sell, 2009; Nair et al., 2011). Substrates are materials, other than soils in situ, which support the growth and development of plants. Substrates can either be of organic origin, e.g., tree bark, poultry feathers, peat, compost, or made up of inorganic materials such as vermiculite, mineral wool, and clay (Vaughn *et al.*, 2011;Okunlola, 2016). According to Nair *et al.* (2011), substrates may also contain both organic and inorganic materials such as peat and perlite; coir and clay, peat and compost.Growing media play three significant roles in the plant; it provides aeration and water, allows for maximum root growth and physically supports the plant (Okunlola, 2016). In the last decade, many authors have researched the effects of growing media on the yield of vegetables, and these studies have established the significance of growing media to plant root growth and development.The inorganic media enhance plant growth and development compared to organic ones (Böhme et al., 2001; Okunlola and Oyedokun, 2016). Results from Tzortzakis and Economakis (2008) contradict previous findings. The authors found that plants grew faster in organic media compared to inorganic media. For yield enhancement, several authors have recommended growing vegetables in inorganic media (Rockwool, sand) rather than organic media (Böhme et al., 2001; 2008; Ikeda et al., 2001; Kobryń, 2002). Addition of inorganic substances to organic substances produces higher yield probably owing to increasing water-holding capacity and aeration by organic substances, which demonstrates that inorganic substances could partially replace organic substances (Gao et al., 2010).

However, there is limited information on the effects of the growing medium on root development and growth of ornamental plants such as *Sansevieria spp*. Therefore, the current study aims to examine the influence of different

propagation substrates on rooting development of *Sansevieria spp*.

II. MATERIALS AND METHODS

A Completely Randomized Design (CRD) experiment was conductedat the Crop Type museum of the Department of Crop, Soil, and Pest Management, Federal University of Technology, Akure, Ondo State ($7^0$16'N, $5^0$12'E) located in the rainforest zone Southwest Nigeria.

Procurement and preparation of planting material

Healthy leaves of *Sansevieria* plant were obtained from the LUCADO horticultural garden, Akure, Ondo State. Selection of the leaves were based on the thickness and colour of the plant; the thick flesh and good colored leaves were selected. The leaves were cut near the base using a pair of scissors,and it was cut at a 45^o angle (approximately 2.5 cm above the top of the soil). Each end of the leaves was marked for easy identification of parts that will develop into the shoot and root when planting. The *Sansevieria* cuttings were stored in a warm, dry area with proper ventilation for a week. Substrateswere filled in polythene pots, watered and the water was allowed to drain for 10 minutes before potting the cuttings. Watering was done at 2 days interval and emerging weeds were hand-pulled from the pots. Root production was checked by gently digging around the base of each cutting with the tip of a pencil.

Substratesused

i. Topsoil,
ii. Sawdust,
iii. Rice hull,
iv. Sand,
v. Combination of above substrates (Topsoil + Sawdust + Rice hull + Sand)

Substrates Analysis

Before planting, all substrates were analyzed to determine their physiochemical properties.The physiochemical analysis carried out include; Particle Size Analysis, Soil pH, Organic Matter, Potassium (K), available Phosphorus, Calcium (Ca^{2+}) and Magnesium (Mg^{2+}), Nitrogen,

Data collection and techniques

Data were collected weekly on plant height and number of fresh leavesfrom 9– 14 weeks after shoot emergence. At the end of the experiment, the root length, root weight, shoot length and shoot weight data were measured and recorded. Data were analyzed using SPSS version 17.0 and mean separation was done using Duncan's New Multiple Range Test (DMRT) at $P<0.05$.

III. RESULT

The result presented in Table 2 showed the effect of different substrates on days to shoot emergence of *Sansevieria trifasciata* (Dwarf). Significant differences ($p<0.05$) were recorded on days to shoot emergence of *Sansevieria trifasciata*.The *Sansevieria* cuttings planted in the Sand substrates and substrate combination of Topsoil + Sawdust + Rice hull + Sand emerged 49 days after planting, followed by Sansevieria cuttings planted in the Topsoil growing media (50 days after planting DAP). The *Sansevieria* cuttings planted in the sawdust substrates emerged last at 53 DAP.

Results from Table 3 showed the effect of different substrates on the plant height for *Sansevieriatrifasciata*. A significant difference ($P<0.05$) was recorded in the plant height of *Sansevieriatrifasciata* across the weeks throughout the durationof the experiment (9-14 WAP). However, the treatment that had all the substrate combination (Topsoil + Sawdust + Rice hull + Sand) had the tallest plant followed by Sand and Topsoil. Rice hull substrates had the shortest mean value for most of the parameters considered during the experiment (plant height, number of leaves, Root length, Shoot length, and Shoot weight).

Table 4 showed the response effects of different substrates on leaf number of *Sansevieriatrifasciata* (Dwarf). The result showed significant differences ($P<0.05$) in the number of leaves across the weeks throughout the experiment, although most of the substrates were not significantly different from one another. *Sansevieriatrifasciata*planted Topsoil + Sawdust + Rice hull + Sandwere not significantly different from the one planted in the Sand. The least number of leaveswas recordedinRice husk.

The results in Table5showed the effect of different substrates on the root length, root weight, shoot length and shoot weight for *Sansevieriatrifasciata* (Dwarf). There were significant differences ($P<0.05$) in root length, root weight, shoot length and shoot weight. However, it was observed that the mean value of root length, root weight, shoot length and shoot weight were highest in the treatment combination (Topsoil + Sawdust + Rice hull + Sand) followed by Sand and Topsoil. The rice hull had the least mean value.

IV. DISCUSSION

This research finding clearly showed that substrates play an essential role in the propagation of plants and root development. Results from the study revealed that there were significant differences among the treatments throughout the duration of the experiment. It was observed that sand performed better than other substrates(except the combination)for the plant height, number of leaves, shoot

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length, root weight, root length and shoot weight. The substrate combination (Topsoil + Sawdust + Rice hull + Sand) enhanced the growth and development of Sansevieria trifasciata. The addition of sand to the substrate combination contributed immensely to it's performance, owing to the ability of sand to retain the right amount of moisture for the plant. This study has also revealed the importance of growing media in root development as earlier highlighted by several authors. Ikeda et al. (2001) stated that inorganic substrates enhanced growth and development of vegetables. Tzortzakis and Economakis (2008) found that plants grew faster in organic media compared to inorganic media. The study further confirmed that inorganic substrates (sand) performed better than the other substrates except for the combination of Topsoil + Sawdust + Rice hull + Sand. The sand substrate had Sansevieria trifasciata with the highest root length, root weight, shoot length and shoot weight mean value. The excellent performance of substrate combination (Topsoil + Sawdust + Rice hull + Sand) may be due to the presence of sand in the media combination. This result conforms with the finding of the following authors Böhme et al., (2001; 2008); Ikeda et al., (2001); Kobryń, (2002); Okunlola and Oyedokun, 2016. The findings from the authors explained that for yield enhancement in vegetables it is better to grow it in inorganic media such as Rockwool or sand. However, the treatment combination of Topsoil + Sawdust + Rice hull + Sand is a typical example of organic and inorganic substrates added together which performed better. than other substrates; the properties of individual substrates may be responsible for this. The organic substrates will help increase water holding capacity and improve aeration while the inorganic substrates will provide required nutrients necessary for plant development. Findings from Gao et al. (2010) also confirmed this result. Stating that the addition of inorganic substances to organic substances produce higher yield probably owing to increased water-holding capacity and aeration by organic substances (Gao et al., 2010).

V. CONCLUSION

The study provide empirical evidence that the performance of the Sanseveria species planted with sand had better results than those planted with topsoil, sawdust, and rice hull. Sansevieria spp planted with sand had the best performance . However, a combination of organic and inorganic growing media will be recommended owing to its ability to enhance rooting development and vegetative growth. Further research is expected to be conducted to also examine the response of other Sansevieria species to different growing media or substrate.

List of Tables

Table.1: Physiochemical properties of different substrates

	Topsoil	Sand	Rice Husk	Sawdust
		Substrates		
Particle size analysis (%)				
Clay	18.67	12.67	0	0
Silt	39.67	5.67	0	0
Sand	41.66	81.67	0	0
Soil pH	5.98	5.96	5.33	5.3
Nitrogen (%)	0.33	0.11	3.52	3.67
Phosphorus (mg kg^{-1})	5.07	3.13	34.14	17.48
Organic Matter	3.19	0.42	34.67	32.33
Exchangeable cation (cmol kg^{-1})				
Potassium	0.80	0.61	2.78	2.73
Calcium	1.14	0.45	13.81	16.99
Magnesium	3.00	2.97	12.93	13.63

Table.2: Effect of different substrates on days to shoot emergence of Sansevieriatrifasciata (Dwarf)

Substrates	Shoot emergence (days)
Topsoil	50ab
Sawdust	53a
Rice hull	52ab
Sand	49b
Topsoil + Sawdust + Rice hull + Sand	49b

Means with the same letter in the same column are not significantly different from one another

Table.3: Effect of different substrates on plant height of Sansevieriatrifasciata (Dwarf)

Substrates	9	10	11	12	13	14
	Weeks after planting					
Topsoil	1.60b	2.23b	3.20b	4.17b	4.50b	6.30c
Sawdust	0.87c	1.77c	2.43c	3.43c	4.20b	5.33d
Rice hull	0.57d	1.40c	2.07c	2.93d	3.70b	4.67e
Sand	2.00a	3.50a	4.27a	5.63a	7.13a	10.03a
Topsoil + Sawdust + Rice hull + Sand	2.07a	3.67a	4.43a	5.43a	6.50a	7.97b

Means with the same letter in the same column are not significantly different from one another

Table.4: Effect of different substrates on leaf number of Sansevieriatrifasciata (Dwarf)

Substrates	9	10	11	12	13	14
	Weeks after planting					
Topsoil	1.00a	2.00b	2.67c	4.00b	4.00c	6.00b
Sawdust	0.00b	1.33c	2.00c	3.00c	4.00c	4.67c
Rice hull	0.00b	1.00c	2.00c	3.00c	3.00d	4.00c
Sand	1.67a	3.00a	3.33b	4.33b	5.67b	8.33a
Topsoil + Sawdust + Rice hull + Sand	1.67a	3.00a	4.00a	6.00a	8.00a	8.67a

Means with the same letter in the same column are not significantly different from one another

Table.5: Effect of different substrates on growth parameters of Sansevieriatrifasciata (Dwarf)

Treatments	Root length (cm/plant)	Root weight (g/plant)	Shoot length (cm/plant)	Shoot weight (g/plant)
Topsoil	9.23c	1.28b	7.12c	15.68b
Sawdust	8.13d	0.73c	6.30d	10.00c
Rice hull	7.83d	0.74c	6.23d	10.33c
Sand	10.3b	1.32b	9.37b	18.67a
Topsoil + Sawdust + Rice hull + Sand	11.23a	1.62a	10.43a	18.00ab

Means with the same letter in the same column are not significantly different from one another

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